Total No. of Questions—**12**] [Total No. of Printed Pages—**4+1**

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S.E. (Electrical) (I Sem.) EXAMINATION, 2011

MATERIAL SCIENCE

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. **:—** (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Answer Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I.

(*iii*) Answer Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic table, slide rule and electronic calculator is allowed.

(*vi*) Assume suitable data, if necessary.

Physical Constants **:**

(1) Angstrom Unit (AU) = 1×10^{-10} metres.

(2) Boltzmann's constant (K) = 1.38×10^{-23} Joule-degree^{-1}.

(3) Charge on electron (e) = 1.601×10^{-19} coulombs.

(4) Mass of electron (m) = 9.107×10^{-31} kg.

(5) Permeability of free space (μ_0) = $4\pi \times 10^{-7}$.

(6) Mass of proton (m_p) = 1.627×10^{-27} kg.

P.T.O.

(7) Velocity of light (C) = $2.998 \times 10^{+8}$ metre/second.

(8) Electron volt (eV) = 1.602×10^{-19} Joules.

(9) Debye unit = 3.33×10^{-30} coulomb-metre.

(10) Dielectric constant of free space ($\mathbb{m}_0$) = 8.85×10^{-12} farad-metre^{-1}.

SECTION I

1. (*a*) Derive Clausius-Mosotti relation from the first principle applied to dielectric materials. State the assumptions. [8]

(*b*) Calculate the electronic polarizability of Argon atom. Given $\hat{\mathbb{I}}_r$ = 1.0024 at NTP and N = 2.8×10^{25} atoms/m^3. [4]

(*c*) What is meant by loss tangent as referred to polar dielectrics ? Give its significance. [4]

Or

2. (*a*) Write different materials used for photo-voltaic cell. With neat sketch describe its construction and working principle. [8]

(*b*) Explain the following : [8]

(*i*) Ferro-electricity

(*ii*) Electronic polarization.

3. (*a*) Discuss the insulating materials used for : [8]

(*i*) Power transformer

(*ii*) Line insulators.

(*b*) State different mechanisms of breakdown in vacuum. Explain any *one* in detail. [8]

Or

4. (*a*) State the properties and applications of : [8]

(*i*) SF_6 gas

(*ii*) Ceramics

(*iii*) Asbestos

(*iv*) Transformer oil.

(*b*) What is meant by Townsend's primary and secondary ionization coefficient ? Explain various factors affecting the breakdown strength of solid insulating materials. [8]

5. (*a*) Explain classification of magnetic materials on the basis of distribution of dipole moments. Give application of each class. [8]

(*b*) Differentiate between :

(*i*) Soft and hard magnetic materials [5]

(*ii*) Permeability and magnetic susceptibility. [5]

Or

6. (*a*) What is Curie temperature for ferromagnetic material ? Explain spontaneous magnetization and Curie-Weiss law. [9]

(*b*) Write short notes on :

(*i*) Magnetic recording materials [5]

(*ii*) Compact discs. [4]

SECTION II

7. State the properties and applications of : [16]

(*i*) Tungsten

(*ii*) Eureka

(*iii*) Kanthal

(*iv*) Nichrome.

Or

8. (*a*) Why is carbon preferred for brushes in electric machines ? [4]

(*b*) What are the groups into which solders are grouped ? Give their applications. [4]

(*c*) Describe in brief the properties and applications of aluminium as conductive material. [4]

(*d*) Write a short note on 'Thermocouples'. [4]

9. (*a*) What are carbon nanotubes ? Discuss their electrical, mechanical and vibrational properties. Give some applications of carbon nanotubes. [10]

(*b*) Write a short note on 'BN nanotubes'. [6]

Or

10. Write short notes on : [16]

(*i*) Single electron transistor

(*ii*) Molecular machine

(*iii*) Nano wire

(*iv*) Carbon clusters.

11. (*a*) With a neat connection diagram, explain the method for determining dielectric strength of transformer oil as per IS Code of Practice. What inferences will you draw from the test ? [10]

(*b*) What is partial discharge of a dielectric ? Explain a method to determine the partial discharge of solid dielectric in laboratory. [8]

Or

12. (*a*) With a neat connection diagram explain the method for measurement of dielectric strength of air as per IS Code of practice. What inferences will you draw from this test ? [10]

(*b*) Explain loss tangent in dielectric materials. Describe the method of measurement of tan δ of a dielectric by schering bridge as per IS code of practice. [8]